REMARKS

Claims 1-20, all the claims pending in the application, stand rejected. Upon review of the language of the rejected claims, Applicants concluded that a clearer and more precise statement is warranted so that the novel features are more readily apparent. Rather than rewriting the claims, Applicant has prepared a new claim set that includes those revisions in clean form. Thus, claims 1-20 are cancelled and new claims 21-43 are added. The subject matter of the new claims is supported by the original claims and the original disclosure. No new matter is added..

Claim Rejections - 35 U.S.C. § 102

Claims 1-20 are rejected under 35 U.S.C. § 102(b) as being anticipated by Lemons et al (4,213,818). This rejection is traversed for at least the following reasons.

As already noted, the rejected claims are cancelled, rendering the rejection of these claims moot. However, substitute new claims 21-43 are directed to the same subject matter, but state the invention in language that is clearer and more precise. In this regard, new independent claim 21 corresponds to original independent claim 1; new independent claim 31 corresponds to original independent claim 9; and new claims 39 and 43 correspond to original claim 18. Accordingly, the following comments are directed to the new claims 21-43 and the manner in which the invention is clearly distinguished from the prior art.

The Invention

The present invention is concerned with a technique of forming a very fine pattern on a chromium-based film by etching the chromium-based film through a resist pattern operable as a mask. As described in the specification, an object of the present invention is:

to minimize a conversion difference (as is referred to in page 2, lines 22 to 26 of the present specification) between the resist pattern and a pattern formed on the chromium-based film, to thereby suppress a variation of the conversion difference depending upon a pattern size; and

to avoid generation of tapered portions on side walls appearing in a section of the patterned chromium-based film, to thereby form vertical side walls in the section.

In other words, since the conventional methods could not sufficiently control etching of side walls in a resist pattern, the present invention was developed.

In developing the invention, on the basis of their investigations, the present inventors noted that such tapered portions tend to appear on the side walls due to radicals that were generated on etching when plasma was excited by applying plasma excitation power to an etching gas. More specifically, the present inventors found that, when oxygen gas was used as the etching gas, oxygen radicals resulting from the oxygen gas could excessively serve to accelerate isotropic etching of the pattern and, as a result, the etching of the side walls would be undesirably promoted. Under the circumstances, the present inventors concluded that suppression of the radicals would bring about an etching with a desired high precision.

Claim 21

Given this conclusion, the present invention as defined in claim 21 is a method of etching a chromium-based thin film that is featured by an express requirement that a power lower than plasma excitation power at which a plasma density jump occurs, when etching is carried out by applying plasma excitation power to an etching gas and by exciting plasma in the etching gas. This feature is not taught in Lemons et al.

Lemons et al reference merely discloses a relationship between power in etching and a etch rate (see Fig. 12). In addition, Lemons mentions a power range falling within 200 and 300 watts. While this range is similar to an example of a power level disclosed in the present specification, it is not a basis for concluding that the express limitation with respect to a relative power level in claim 21 is expressly met, is inherent or even obvious in view of the teachings of Lemons et al..

As to an express teaching of a power lower than plasma excitation power at which a plasma density jump occurs, there is none. As to a conclusion that the power range necessarily suggests such feature, Applicants respectfully submit that the cited power range in Lemons et al could depend on many factors, such as a size of a chamber. This prevents any conclusion of inherency. Moreover, even as to obviousness, there is no disclosure or even suggestion in Lemons et al as to why the stated power range is used. Indeed, since there is no mention of plasma density jump, one of ordinary skill in the art cannot know or determine whether or not the

power range disclosed by Lemons et al is higher than the plasma density jump. Applicant submits that a person of skill in the art is very likely to consider that plasma excitation power should be higher in order to accomplish high etching efficiency, rather than lower. Thus, no motivation could exist according to Lemons et al with respect to the application of a lower power.

By contrast, Applicants have clearly disclosed that it is very important in the present invention that recognition should be made about power at which plasma density jump occurs and power lower than the plasma density jump must be selected and used in the present invention. Thus, for this reason alone, Applicant submits that the present invention is not anticipated by or even obvious over Lemons et al.

A further reason is that Lemons et al does not recognize the need for vertical side walls, as is evident form the etching method illustrated in Figs. 6 to 9 of Lemons et al. As is expressly shown from these figures, , all of an oxide layer (118), such as SiO_2, a metal layer (119), and a photo resist layer (121) in Figs. 6 to 9 form tapered side walls, In fact, Lemons et al teaches in column 6, lines 7 to 13, "therefore, isotropic behavior is attained during the etching operations. This leads to edge profiles of approximately 45° for uniform layers. Different slopes can be obtained in graded layers by control of the fast lateral etching rate of the deeper portion of the layer as....". No mention is made of a vertical wall.

From this fact, one skilled in the art would readily understand that the object of Lemons et al is to form sloped or tapered side walls. This goal is completely different from the present invention, as already noted. Thus, the method described in Lemons et al would never be satisfied with the limited conditions stated for the present invention. In other words, the method taught in Lemons is more closely akin to an etching configuration illustrated as a comparative example in Fig. 7 of the present specification, rather than the invention itself.

Finally, Applicants note that there is no suggestion at all in Lemons et al with respect to suppressing etching on side walls of the resist pattern so as to obtain perpendicular side walls. This is because the thought of Lemons el at is inverse to that of the present invention. Thus, Applicants would submit that the present invention is not obvious from Lemons et al.

Claim 22

Applicants respectfully note that claim 22 is dependent on claim 21 and requires that an organic substance is generated by etching a resist. This is because the organic substance generated by etching the resist and be deposited onto the side walls of pattern is effective to suppress the etching of the resist side walls and prevent from diminishing. Specifically, an etching selectivity of an etching rate of the chromium-based thin film with respect to the resist layer is defined as less than 1.5. This means that it is possible to generate a sufficient amount of the organic substance from the resist.

Lemons et al never teach about the above-mentioned concept and effect. On the contrary, Lemons et al disclose etching selectivity that is not smaller than 20 in column 6, line 53. From this perspective as well, the present invention clearly differs from Lemons et al.

Claim 31

Claim 31 defines the invention as a method of etching the thin film in the presence of an organic substance different from the resist. The organic substance is sufficient to suppress the etching of the side walls of the resist. This method is very effective to avoid undesirable etching of the resist side wall, even when the surface of the resist layer on the chromium-based thin film is relatively small.

Since there is neither a disclosure nor suggestion in Lemons et al about the subject matter of claim 31, Applicant respectfully submits that the claim 31 and its dependent claims are also patentable over Lemons et al.

Claim 39

The foregoing discussion with respect to claim 21 would apply to claim 39 as well, which is directed to a method of manufacturing a photo mask from a photomask blank by an etching process using a plasma excitation power that is lower that a plasma excitation power at which a plasma density jump occurs so that a vertical sectional shape can be attained.

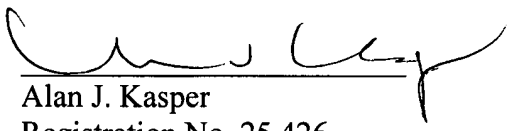
Claim 43

The foregoing discussion with respect to claim 31 would apply to claim 43 as well, which is directed to a method of manufacturing a photo mask from a photomask blank by an etching process using in the presence of an organic substance different from the resist.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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